628.1
L75
1908

CITY OF LIVERPOOL.

*

Water Works.

*

REPORT of ENGINEER

For the Year

1908.

CITY OF LIVERPOOL.

Water Works.

ANNUAL REPORT

OF THE

ENGINEER

FOR THE

Year 1908.

(Printed in accordance with a Resolution of the Water Committee.)

LIVERPOOL:
C. Tinling & Co., Ltd., Printing Contractors, 53, Victoria Street.

1909

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628.1
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1908

City of Liverpool.

Lord Mayor:

The Right Honourable
HAROLD CHALONER DOWDALL, J.P.,

Water Works Committee of the City Council, Year 1908-1909:

Alderman WILLIAM J. BURGESS, J.P., *Chairman.*
Councillor ROBERT S. PORTER, *Deputy Chairman.*

Aldermen:

EDMOND BROWNBILL, J.P.,	JAMES LISTER, J.P.,
EDWARD HATTON COOKSON, J.P.,	WILLIAM RADCLIFFE, J.P.,
CHARLES H. GILES, J.P.,	FREDERICK SMITH, J.P.,
EDWARD GRINDLEY, J.P.,	JOACHIM N. STOLTERFOHT.

Councillors:

JAMES BOLGER,	JOHN JAPP, J.P.,
ROBERT L. BURNS,	GEORGE JEREMY LYNSKEY,
WILLIAM DENTON, J.P.,	CHARLES H. RUTHERFORD,
JOHN L. EILLS, J.P.,	WILLIAM P. WETHERED,

O. HARRISON WILLIAMS.

Quint Ex, 1908

Representatives appointed by the Corporation of Bootle, pursuant to Section 5, Sub-Section 4, of "The Liverpool Corporation Act, 1890."

W. R. BREWSTER, J.P., BENJAMIN CAIN, J.P.

Estate Sub-Committee.

Councillor WILLIAM DENTON, J.P., *Chairman.*
Councillor CHARLES H. RUTHERFORD, *Deputy-Chairman.*

Aldermen:

EDMOND BROWNBILL, J.P.,	CHARLES H. GILES, J.P.,
WILLIAM J. BURGESS, J.P.,	FREDERICK SMITH, J.P.

Councillors:

JOHN JAPP, J.P.,	ROBERT S. PORTER,
GEORGE J. LYNSKEY,	O. HARRISON WILLIAMS.

W. R. BREWSTER, J.P. (*Bootle Representative*).

Town Clerk:	Chief Engineer:
EDWARD R. PICKMERE, M.A.	JOSEPH PARRY, M.Inst.C.E.

TELEPHONE No. 6004 CENTRAL.
TELEGRAMS: WATER ENGINEER, LIVERPOOL.

Principal Officers, and Officers in charge of Sub-Departments, in the Liverpool Water Works.

Engineer-in-Chief	JOSEPH PARRY, M.Inst.C.E., Municipal Offices, Liverpool.
Principal Assistant Engineer	THOMAS DUNCANSON, M.Inst.C.E., Municipal Offices, Liverpool.
Assistant Engineer	J. R. DAVIDSON, M.Sc., Assoc.M.Inst. C.E., Municipal Offices, Liverpool.

INDOOR STAFF, MUNICIPAL OFFICES, LIVERPOOL.

Chief Clerk and Superintendent Assessor of Water Charges.	R. C. F. ANNETT, Assoc.Inst. C.E.
Superintendent of Drawing Office	HENRY SHAWCROSS, B.E.
Chief Engineer's Secretary	GEORGE T. BLENKINSOP.
Assistant Chief Clerk	OSWALD J. MANSON, Assoc.Inst. C.E.

OUTDOOR STAFF, LIVERPOOL.

Superintendent of Pipe Laying	A. JOWETT.
Do. District Turncocks	W. S. THOMPSON.
Do. Dock Turncocks	RICHARD PARRY.
Do. Waste Water and Plumbing Inspectors	WILLIAM MASON.
Do. Testing and Stamping Office, Pall Mall.	THOMAS FOULKES.
Assessor of Water Charges	All Districts—J. N. T. HOLLIDAY (Principal Assessor).
Do.	North District—A. B. HOLLAND.
Do.	East ,, A. ELLIOTT.
Do.	South ,, T. J. DUTTON.

RIVINGTON WORKS.

Resident Engineer	R. A. ADAMSON, Office, Horwich, Nr. Bolton.

VYRNWY WORKS.

Resident Aqueduct Engineer	F. W. GASKIN, Assoc M.Inst.C.E., Office, Llanforda, Oswestry.
Resident Engineer (New Works)	H. N. GILES, B.Sc., B.Eng., Assoc.M.Inst.C.E.
Resident Inspector, Lake Vyrnwy	S. GLOSSOP, Office, Lake Vyrnwy, *via* Oswestry.

CHORLEY WORKS.

Resident Superintendent	G. E. EVANS, Town Hall, Chorley.

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LIVERPOOL CORPORATION WATERWORKS.

ENGINEER'S REPORT

For the Year ending 31st December, 1908

(being the Tenth Annual Report).

Consumption of Water.

Total delivery.

The average quantity of water supplied per day from the works of the Corporation during the year ending 31st December, 1908, was 32,111,000 gallons. The corresponding average for the year 1907 was 30,928,000 gallons. There was, therefore, last year an increase of 1,183,000 gallons per day, or nearly 4 per cent. over the quantity supplied in the previous year.

These average figures do not, however, represent the full demand on the resources of the Corporation. During periods of frost and during hot summer weather, the consumption rises much above the average.

The maximum quantity consumed in any one day last year was, in winter over 47,000,000 gallons, and in summer 36,500,000 gallons.

Details of Consumption.

In the following table particulars are given of the total average daily quantities supplied for different purposes, also of the average daily quantities per head of the population.

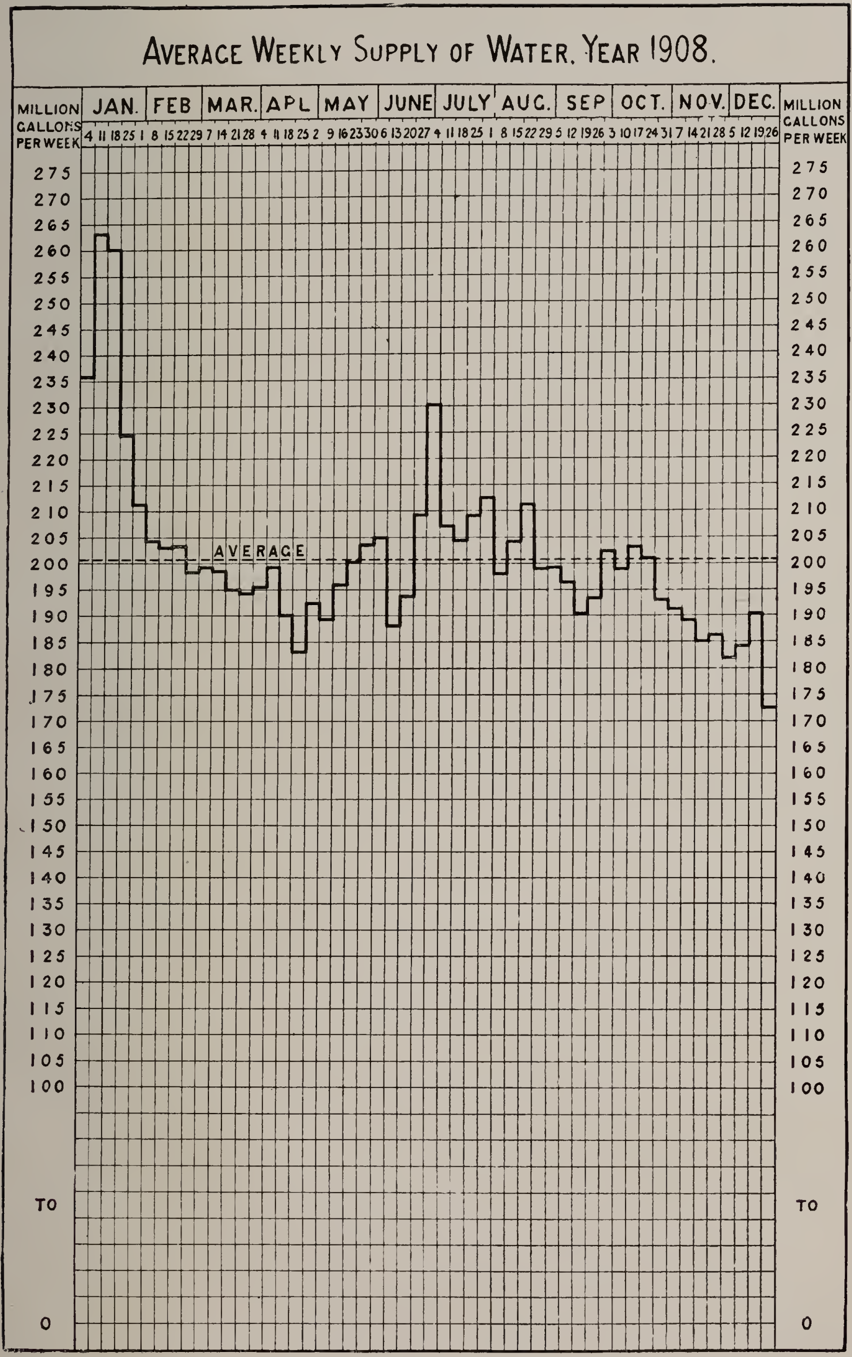
The quantities supplied for the preceding year (1907) are given in parallel columns.

TABLE I.

	Total for 52 weeks ended 31st December, 1908.	Average per Day.	Population (mean of Year).	Average Rate per Head per day.	Total for Year 1907.
	Gallons.	Gallons.		Gallons.	Gallons.
SUPPLIED WITHIN AND AROUND THE CITY (Compulsory Area).					
For trade purposes, by meter	2,538,519,000	6,974,000		7·684	2,617,784,000
For ships, by meter	255,521,000	702,000		0·773	251,239,000
For workhouses and industrial schools, by meter	272,490,000	748,000		0·825	255,299,000
For miscellaneous purposes, by assessment (quantity estimated).	602,951,000	1,656,000		1·825	596,403,000
For public purposes, including flushing sewers and drains, watering and washing streets, public baths and washhouses, fountains, cattle troughs, urinals, &c...	631,742,000	1,736,000		1·911	596,447,000
For extinguishing fires	12,127,000	33,000		0·037	18,943,000
For domestic purposes, hotels, public-houses, warehouses, offices, shops, and all waste and leakage from public and private pipes and fittings	6,097,153,000	16,751,000		18·455	5,662,954,000
Salt water supplied for public purposes	42,316,000	116,000		0·128	42,858,000
Water for condensing at the Pumping Stations	23,241,000	64,000		0·070	16,132,000
	10,476,060,000	28,780,000	907,649	31·708	10,058,059,000
SUPPLIED OUTSIDE OF THE LIVERPOOL AREA.					
In the town of Chorley	211,404,000	581,000	30,000	19·359	192,373,000
In towns and districts supplied in bulk from the Rivington and Vyrnwy aqueducts (including Standish, Leigh, Hindley, Abram, Haydock, Ashton, Ince, Withnell, Bulkeley, Bunbury, Ellesmere, Little Budworth, Malpas, Sutton, Tarporley and Wallasey).	1,000,979,000	2,750,000	*170,000	—	1,007,361,000
Total	11,688,443,000	32,111,000	1,107,649	—	11,257,793,000

* Excluding Wallasey

Diagram A.


AVERAGE WEEKLY SUPPLY OF WATER. YEAR 1908.
MILLION GALLONS PER WEEK
JAN. FEB MAR. APL MAY JUNE JULY AUG. SEP OCT. NOV. DEC.
4 11 18 25 1 8 15 22 29 7 14 21 28 4 11 18 25 2 9 16 23 30 6 13 20 27 4 11 18 25 1 8 15 22 29 5 12 19 26 3 10 17 24 31 7 14 21 28 5 12 19 26
275 270 265 260 255 250 245 240 235 230 225 220 215 210 205 200 195 190 185 180 175 170 165 160 155 150 145 140 135 130 125 120 115 110 105 100
TO
0
AVERAGE

Quantities per Week.

The fluctuations from week to week are represented graphically on Diagram A, from which it will be seen that the maximum demand in any one week was 263,403,000 gallons, and the minimum demand 172,958,000 gallons per week.

Extinction of Fires.

The total number of Fires reported to the Water Department during the year was 352, and the number for the extinguishment of which water from street hydrants was used was 130. 222 fires were extinguished by chemical engines and buckets of water without the use of the street hydrants.

Description of Premises in which the Fires occurred.	Number of Fires.	Maximum No. of Hydrants used at one Fire.	Total No. of Hydrants used.
Warehouses	20	15	58
Manufactories and Workshops	25	17	91
Offices, Shops and Stores ...	39	4	54
Dwelling Houses	10	2	11
Steamers and Sailing Ships ...	9	7	17
Farms	7	2	11
Garage, Stables and Shippons	7	9	20
Churches and Schools ...	2	1	2
Timber Yards	3	24	38
Railway Stations	3	1	3
Streets	5	2	6
	130		311

Tabulated according to the localities where the Fires took place, there were :—

	Fires extinguished by jets from Street Hydrants.
In the City	107
„ Bootle	12
„ Waterloo	1
„ Litherland	1
„ West Derby Rural	1
„ Prescot	2
„ Crosby	3
„ Blundellsands	1
„ Ince Blundell	1
„ Sefton	1
	130

Water Tenants.

The number of new premises supplied with water in and around the city during the year was 2,633. The number from which water was cut off, chiefly in consequence of demolitions, was 735, leaving a net number of 1,898 additional water tenants. The total number of tenants on the Rent roll of the Department at the end of the year was 199,917.

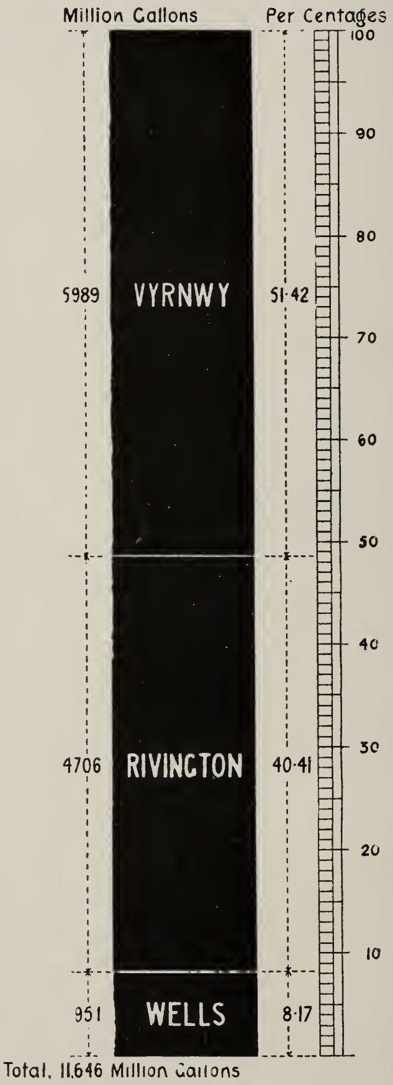
Sources of Supply.

It will be seen from Table I. that the total volume of water distributed during the year amounted to 11,688,443,000 gallons. The quantities obtained from the several sources of supply were :—

	Gallons.
FROM VYRNWY	5,988,574,000
„ RIVINGTON	4,706,399,000
„ WELLS	951,154,000
SALT WATER	42,316,000
Total	11,688,443,000

In Diagram B these proportions are shewn graphically, omitting the Salt Water.

Diagram B.



Liverpool Corporation (General Powers) Act, 1908.

WATER PRESSURE AND WATER CHARGES.

In an omnibus Bill promoted in the Session of 1908 the Corporation included provisions for amending the Water Acts in respect of the following three matters:—

1. To repeal or amend Agreements entered into in the year 1880 for the supply of water to the towns of St. Helens, Warrington, and Widnes.
2. To re-enact a Clause in the Act of 1862 relating to pressure.
3. To increase the Domestic Water Rents in the Out Townships.

In the first of these matters the application was unsuccessful. The Clause was vigorously opposed, and the Committee of the House of Commons decided "that no strong public case had been made out "which would justify them in coming to the decision to grant this "Clause."

In regard to the second matter, the Clause was not passed in the form proposed by the Water Committee, but important powers were obtained limiting the pressure at which water must be delivered, and removing the ambiguities of former enactments.

With regard to the revision of water charges, a longer explanation is necessary.

Prior to the year 1862 the charges for domestic supplies were uniform throughout the compulsory area, and, therefore, no distinction was made between Liverpool and the Out Townships. The authorised rates applied to all houses requiring water from the works of the Corporation, whether situated within the Borough or beyond its limits. In 1862 a new system of charging was introduced. The Corporation obtained power to levy a fixed public Water Rate of 6d. in the £ on all property within the Borough liable to Poor Rate Assessment, whether receiving a supply of water or not. Premises receiving a domestic supply in the Borough were required to pay, in addition to the 6d. Public Rate, a Domestic Water Rent not exceeding 5 per centum per annum on the Net Rateable Value. As there was no precedent for levying a public rate outside of the Borough (in the jurisdiction of another Local Authority), premises taking a domestic supply in the Out Townships were, by the Bill as first drawn, required to pay 6d. in the £ more for Water Rent than similar property inside, thus balancing the 6d. rate payable by the domestic consumers inside. This was opposed in the Town Council, and was altered to 3d. in the filled-up Bill, and in that form it was presented to and passed by Parliament.

It is evident that the effect of this new departure was not foreseen, either in respect of the unfair advantage given to the outside consumers, nor yet in the relief afforded to domestic consumers by the increased contributions of non-domestic consumers. In a few years the injustice to the inside householder became apparent, and, in 1871, the Corporation promoted a Bill to raise the outside 3d. to 6d. This was strenuously opposed by the Out Townships, but after a very exhaustive hearing the Bill passed through the House of Commons. It was again opposed in the House of Lords, and, after a short hearing, was rejected.

No further action was taken in the matter until the year 1879, when the Corporation sought to obtain a Provisional Order embodying the provisions of the Bill of 1871 as passed by the House of Commons. After an inquiry before an Inspector, the Local Government Board decided that, having regard to the action of the House of Lords, they could not pass a Provisional Order which would be at variance with the express decision of one branch of the legislature. They expressed no opinion upon the merits of the proposal, but suggested that the desired alteration of the Act of 1862 should be made by a private Bill, and not by a Provisional Order.

The next Omnibus Bill promoted by the Corporation was in the year 1887, and Clauses were introduced, as in 1871, to equalise the water charges between the City and the Out Townships.

Evidence was given by Liverpool to show the unforeseen effect of a fixed public water rate of 6d. in the £, and the Commons Committee amended the Bill by reducing the water rate to 3d.

By this amendment, the object of the Corporation would have been attained in so far as regards the Out Townships, because the reduction of the water rate in the City would have had the effect of raising the domestic water rents throughout the whole area of supply, including the Out Townships.

The acceptance of the Bill as amended would, however, have had the effect of relieving the occupiers of works, offices and warehouses at the expense of the domestic consumers, and as that change in the method of raising the revenue would have caused great dissatisfaction and inconvenience, and was not contemplated when the Council agreed to promote the Bill, it was decided to withdraw the Water Clauses.

Between 1887 and 1908 two events occurred which affected the position created by the Act of 1862 and delayed further application to Parliament. One was the extension of the 6d. water rate to the Borough of Bootle, under circumstances which need not here be explained, and the second, the enlargement of the City boundaries.

Last year, however, the City Council sanctioned another application to Parliament to increase the domestic rents in the remaining Out Townships.

The Bill was opposed by the Urban District Councils of Allerton, Childwall, Great Crosby, Huyton-with-Roby, Litherland, Little

Woolton, Much Woolton, Prescot and Waterloo-with-Seaforth, the Rural District Council of Whiston, the Marquess of Salisbury and the Earl of Sefton, but the powers applied for were granted, though not in the exact form asked for. In future, the domestic consumers outside are to pay 6d. in the pound more than the inside consumers, instead of 3d. as heretofore. The charge for water supplied by meter is to be uniform throughout the whole of the compulsory area, and the Sanitary Authorities of the Out Townships are to be supplied with water for public purposes at a rate not exceeding 4d. per 1,000 gallons.

It will, I think, assist the Committee in realising the effect of the legislation of 1908 if I give a Tabulated Statement of the actual amounts charged each year since the year 1848, when the works came into the possession of the Corporation. See next page, 17.

In considering any question affecting the water charges in Liverpool, there are two important points to be always kept in view.

The first is, that the Water Undertaking is not a trading concern. The Corporation are not allowed to make any profit from the distribution of water within the compulsory area of supply. An estimate of the revenue and expenditure has to be made at the beginning of each year, and the water rent has then to be fixed at an amount, within the maximum allowed by the Act, that will provide the necessary revenue after taking into account the yield of the 6d. rate and other receipts.

The second point to be remembered is that the bulk of the expenditure of the Water Committee is in respect of Interest on Capital, Sinking and Depreciation Funds and Rates and Taxes. The total expenditure on Ordinary or Revenue Account for the year 1908, excluding Chorley, was £357,153 18s. 10d., of which, excluding rates and taxes, only £77,104 14s. 1d. was for working expenses. The working expenses are actually less than they were over twenty years ago, although the population supplied with water has greatly increased during that period.

TABLE OF DOMESTIC WATER RENTS AND RATES AND CHARGES FOR SUPPLIES BY METER.

Year.	Domestic Water Rents in the £.		Public Water Rate in Liverpool.	Meter Supplies, per 1,000 gallons.	
	Liverpool.	Out Townships.		Liverpool.	Out Townships.
1848 to 1857	From 5°/o to 3°/o on Gross Annual Value	Same as Liverpool	Fluctuating Sanitary Rate 1d. to 3d. in the £.	1s. 1½d. to 9d.	Same as Liverpool
1858 and 1859	do.	do.		1 2	do.
1860	do.	do.		9d.	do.
	s. d.	s. d.			
1861 and 1862	1 2½	1 2½		1s. to 9d.	do.
	On nett Annual Value.	On nett Annual Value.			
1863	0 7½	0 10½	6d.	1s. to 9d.	do.
1864	0 5¼	0 8¼	6d.	7d.	9d.
1865	0 4½	0 7½	6d.	7d.	9d.
1866 and 1867	0 6	0 9	6d.	9d.	11d.
1868 to 1870	0 6¾	0 9¾	6d.	9d.	11d.
1871 to 1878	0 6	0 9	6d.	9d.	11d.
1879 to 1887	0 6	0 9	6d.	7d.	9d.
1888	0 6	0 9	6d.	7d.	10½d.
1889 to 1894	0 7½	0 10½	6d.	7d.	10½d.
1895 and 1896	0 7½	0 10½	6d.	6d.	10½d.
1897 to 1903	0 7½	0 10½	6d.	6d.	9d.
1904	0 6	0 9	6d.	6d.	9d.
1905	0 4¾	0 7¾	6d.	6d.	9d.
1906	0 6	0 9	6d.	6d.	9d.
1907 and 1908	0 7½	0 10½	6d.	6d.	9d.
1909	0 7½	1 1½	6d.	6d.	6d.

EXTENSIONS OF MAINS.

Nearly fifteen miles of new mains were laid during the year in the city and its suburbs. The lengths of different sizes are given in the following Table. The smaller diameters (3 to 5 inches) were extensions for the supply of new houses, or of houses in rural districts not previously supplied by the Corporation. The larger diameters were for fire mains and for trunk mains.

Diameters.	Lengths.
3 inches.	191 yards.
4 ,,	19,342 ,,
5 ,,	1,819 ,,
6 ,,	1,220 ,,
7 ,,	336 ,,
8 ,,	15 ,,
12 ,,	1,165 ,,
15 ,,	528 ,,
21 ,,	1,146 ,,
	25,762 yards.

The 21in. diameter pipes and the 15in. diameter pipes were laid for the better supply of districts to the north of the city, and formed part of the scheme referred to in my last Annual Report for meeting the increasing demands between Bootle and Hightown.

The 12in. pipes were laid between the Parkhill Reservoir and Aigburth Road, in consequence of the increased demand for water caused by the erection of new houses in Aigburth.

Hydrants.

The total number of fire hydrants in the compulsory area is now 15,689. There are also still remaining 497 of the old fire plugs, which are being gradually replaced.

PREVENTION OF WASTE.

In the following statements particulars are given of the work done during the year by the Plumbing and Waste-water Inspectors, also of the water fittings tested and stamped at the Corporation Offices, Pall Mall.

Examinations for Leakages and new Plumbing Work.

NUMBER OF PREMISES VISITED.

FIRST INSPECTIONS.						Re-Inspections after Notices.	Total No. of Inspections.
New Supplies.	Building Alterations.	W.C. Conversions.	Examinations after Night Reports.	House to House Inspections.	Cases from Complaint Office Books.		
16,166	737	274	184,514	1,679	15,263	20,740	239,373

DEFECTS DISCOVERED.

Corporation Pipes.	Private Pipes.	Draw off Cocks, Screw down Cocks Plug Cocks, and Stand Pipes.	Ball Cocks in Store Cisterns.	Water Closet Cisterns.		Total No. of Defects.	No. of defects repaired by Inspectors at the times of inspection.
				Valves.	Ball Cocks.		
614	9,378	14,662	373	12,139	5,971	43,137	16,398

Testing and Stamping Department.

Description of Fittings.	Number tested and charged for.	Number tested but not charged for.	TOTAL.
Draw off Cocks and Stop Cocks	44,357	1,642	45,999
Ball Cocks	6,223	901	7,124
Cisterns with Ball Cocks	6,270	76	6,346
Cisterns without Ball Cocks	592	32	624
TOTAL	57,442	2,651	60,093

The total amount of fees received for testing and stamping taps and cisterns was £621 15s. 3d.

Sources of Supply.

WELLS AND HIGH LEVEL PUMPING STATIONS.

Windsor Well.

Water was pumped from the Windsor Well from the 10th January to the 8th February, to assist in maintaining a constant service in the face of an excessive consumption following a severe frost.

The pumping machinery was kept in working order throughout the year, so as to be ready to start at any moment if required.

Green Lane Well.

During the year the J. Holmes engine worked on 67 days; the G. Holt engine on 315 days; and the J. Cooper was not worked at all.

No extensive repairs were called for during the year, but several minor matters received attention, the most important being some improvements to the hand gear for actuating the valves of the J. Holmes engine; the repairing of a considerable part of the yard in front of the engine houses, and some improvements to the weighing machine.

Dudlow Lane Well and High Level Station.

The fixing of steel girders and cast iron platforms in the well in place of timber work has now been completed.

Aubrey Street High Level Station.

One of the fly wheels of the William Radcliffe engine was found to be cracked, and a new fly wheel had to be obtained and fitted.

New screens have been fixed in the reservoir at this Station, so as to better preserve the purity of the water passing into the mains.

Service Reservoirs.

No. 1 Reservoir at Kensington, the Parkhill Reservoir (High Park Street), and the Torr Street Reservoir were cleaned during the year.

TABLE II.—COST OF PUMPING AT THE VARIOUS STATIONS FOR THE YEAR ENDED 31st DECEMBER, 1908.

STATION.	QUANTITY PUMPED.	COAL AND SLACK.		STORES. (Including Gas.)		WAGES. (Establishment.)		REPAIRS. (Labour and Materials.)		TOTAL.		Total Lift Feet.	Cost per 1000 Gallons per 100 ft. of Lift.
		Cost per Million gals.	Cost per 1000 gals.	Cost per Million gals.	Cost per 1000.	Cost per Million gals.	Cost per 1000 galls.	Cost per Million gals.	Cost per 1000 gals.	Cost per Million gals.	Cost per 1000 gals.		
	Gallons.	s. d.	d.	s. d.	d.	s. d.	d.	s. d.	d.	s. d.	d.		d.
DUDLOW LANE **T. Duncan Engine**	388,833,000	35 1	·4210	3 7	·0431	24 3½	·2913	21 1¾	·2538	84 1¼	1·009	350	0·2883
GREEN LANE—													
J. Holmes Engine...	123,956,000	24 10¼	·2983										
G. Holt Engine ...	431,834,000	19 11½	·2394	3 0	·0360	15 2¼	·1822	17 4¾	·2089	56 8¾	·6809	275	0·2476
J. Cooper Engine ...	Engine not working.												
WINDSOR... ...	30,040,000	32 0¼	·3840	4 0½	·0485	14 3¾	·1719	45 5¼	·5453	95 9¾	1·1497	280	0·4106
AUBREY STREET	1430,111,000	6 11¼	·0833	0 10	·0099	5 2¾	·0628	7 8¼	·0923	20 8¼	·2483	100	0·2483

WEIGHT OF FUEL CONSUMED PER MILLION GALLONS LIFTED, PER 100 FEET—

Dudlow Lane	0·89 Tons.	Windsor	1·21 Tons.
Green Lane	0·80 ,,	Aubrey Street	0·70 ,,

AVERAGE COST OF FUEL PER TON—

Coal	12s. 3d.	Slack	9s. 7d.

RIVINGTON SUPPLY (Maintenance).

Reservoirs.

On the Reservoirs, no works of importance were called for during the year.

Filter Beds.

The filter beds were cleaned an average number of 5¼ times. The total number of stoppages in the working of the beds for cleaning or re-sanding was equal to about one bed being out of use for the whole of the year.

The number of cubic yards of sand washed was 2,750.

Afforestation at Rivington.

The area under nurseries has now been extended to nearly twelve acres. About one million seedlings were lined out during the spring. Owing to the continual rainfall during the summer and autumn, nursery work was exceptionally expensive; all weeds had to be hand picked, as very little hoeing was done. The total number of plants sent out from the nurseries to the different plantations during the year was 185,970. All these were raised from seed.

About two miles of fencing was erected during the year, and four miles of old fencing repaired.

Considerable damage was done in Plantation No. 2 by voles and rabbits girdling the bark and cutting off the tops of the plants. The vacancies thus caused have been filled up, and steps taken to destroy the vermin.

The new areas planted during the year measured altogether 75 acres, and were in Tockholes (No. 6 Plantation), Rakebrook (No. 7 Plantation) and Rivington.

The total number of trees planted in the year was 248,620.

A small quantity of dead and dying trees were felled in Bardley Wood, and realised £30 9s. 6d. The best quality beech sold at 1s. 6d. per cubic foot, and best sycamore 1s. 10d. per cubic foot lying in the wood. Firewood and pea stakes also sold well.

Sanitation.

In Rivington Village the culvert which carries the School Brook through the playground of the Elementary School has been reconstructed by agreement with the Managers.

At the large house known as the " Street " on the margin of the Upper Rivington Reservoir a new sewer, 477 yards in length, has been laid, in order to connect with the sewage filters of the Corporation below the byewash, and thus prevent any possibility of pollution on that part of the watershed.

Diagram C.

Shows the variation of stock in the Reservoirs during the year (page 25).

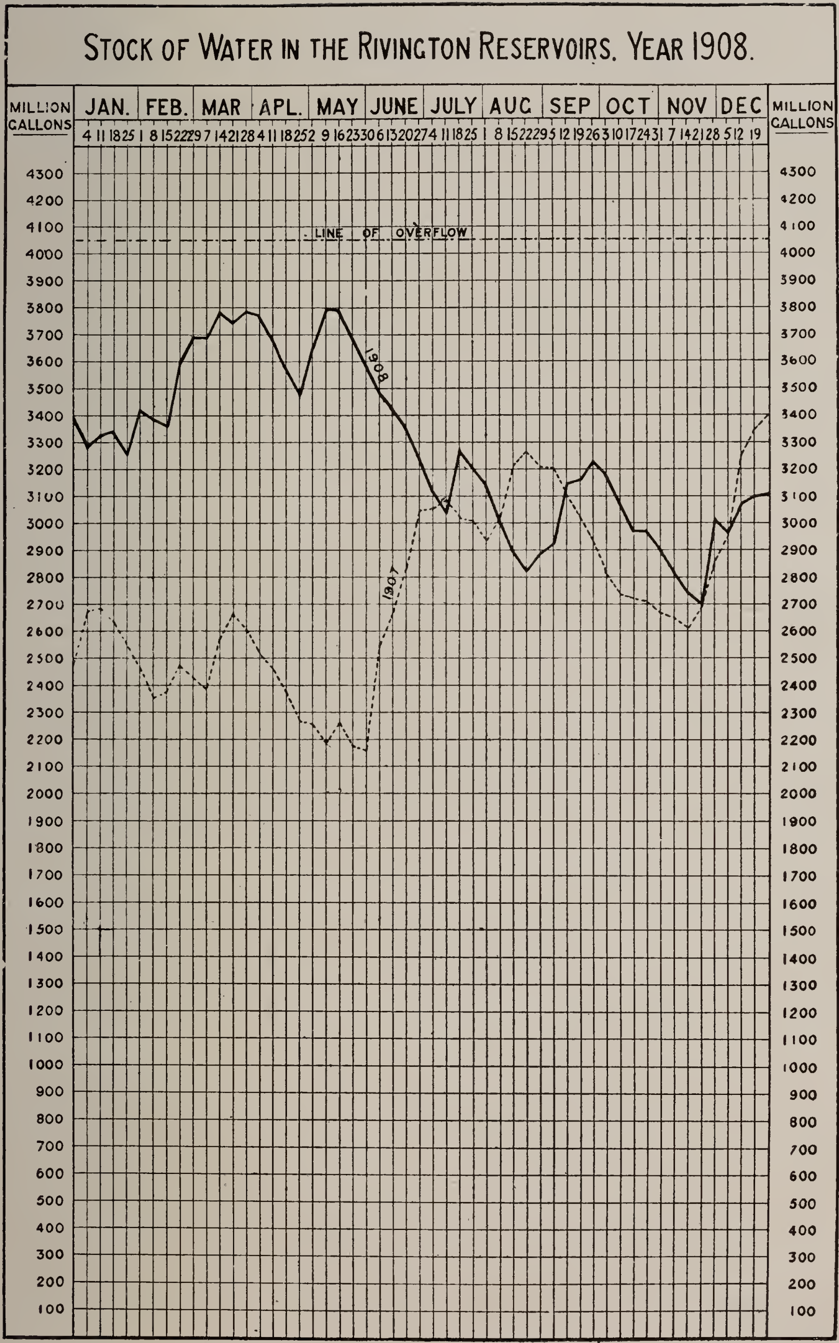
Rainfall.

Particulars of the Rainfall are given in Table III. (page 26).

Rivington Aqueduct.

The Rivington supply was shut off for repairs on thirteen occasions in the course of the year, the total number of days during which the delivery of water was stopped being 18. In addition to repairs of pipes involving the stoppage of the supply, there were 65 leakages from lead joints which were repaired without interrupting the flow to Liverpool. All of these fractures and leakages were caused by subsidence of the ground over coalworkings. As in former years, I have prepared a Table (No. IV.) showing the approximate position of these leakages, measured in miles from the inlet to the aqueduct at the filter beds (see page 27).

Diagram C.



STOCK OF WATER IN THE RIVINGTON RESERVOIRS. YEAR 1908.

TABLE III.—RIVINGTON RAINFALL FOR THE YEAR 1908.

MONTH.	Number of Days upon which rain fell.	NAME AND ALTITUDE OF GAUGES.									
		Higher Hill. O.D. 733 feet.	Game-keepers. O.D. 850 feet.	Coppice Stile O.D 879 feet.	Great Hill. O.D. 1240 feet.	Hurst Hill. O.D. 1029 feet.	Lower Rivington. O.D. 440 feet.	Stones House No. 1. O.D. 623 feet.	Stones House No. 2. O.D. 623 feet.	Brown Hill. O.D. 843 feet.	Lower Knoll. O.D. 742 feet.
		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
January	16	2·51	3·72	2·91	4·02	3·14	3·11	2·82	2·81	2·71	3·10
February ..	24	2·34	4·25	3·63	6·44	3·70	3·46	3·91	3·93	3·60	3·86
March	19	2·64	3·55	2·74	3·33	3·13	3·35	3·51	3·55	2·90	3·42
April	19	1·78	2·56	2·87	3·30	2·84	2·23	3·19	3·20	4·06	2·84
May	19	3·33	3·62	2·92	4·42	3·43	3·78	3·45	3·47	3·33	3·43
June	13	1·85	2·14	1·88	2·38	1·98	1·76	1·89	1·93	1·86	1·80
July..	15	4·62	5·57	4·98	8·91	5·74	4·97	5·09	5·08	5·58	5·61
August	18	3·37	4·25	3·30	6·50	3·63	4·11	3·47	3·46	3·63	3·56
September ..	20	4·32	5·76	5·02	8·02	5·61	5·14	5·63	5·61	5·38	5·44
October	10	1·52	2·13	1·91	2·34	2·18	2·36	2·16	2·15	2·31	2·48
November ..	16	2·74	4·02	3·00	4 03	3·43	2·89	3·07	3·05	2·97	3·02
December ..	19	1·85	2·50	2·18	2·71	2·51	2·61	2·40	2·44	2·24	2·75
Total ..	208	32·87	44·07	37·34	56·40	41·32	39·77	40 62	40·68	40·57	41·31

TABLE IV.—NUMBER OF LEAKAGES FROM LEAD JOINTS ON THE RIVINGTON PIPE LINE REPAIRED DURING THE YEAR 1908.

Month.	Miles Measured along the Pipe Line from Rivington.												Total
	0 to 2.	2 to 3.	3 to 5.	5 to 6.	6 to 7.	7 to 8.	8 to 9.	9 to 10.	10 to 11.	11 to 12.	12 to 13.	13 to 25.	
January ..	—	—	—	—	8	—	—	—	—	—	—	—	8
February ..	—	—	—	—	—	—	—	—	—	—	—	—	—
March	—	—	—	—	2	—	1	—	—	—	—	—	3
April	—	1	—	—	2	—	2	—	—	—	—	—	5
May	—	—	—	—	—	1	2	—	—	—	—	—	3
June	—	—	—	—	1	5	—	1	—	—	1	—	8
July	—	—	—	—	2	—	2	—	—	—	—	—	4
August ..	—	—	—	—	1	1	1	—	—	—	—	—	3
September ..	—	—	—	—	2	3	—	—	1	—	—	—	6
October ..	—	—	—	2	1	3	2	—	—	—	—	—	8
November ..	—	—	—	3	3	1	—	—	—	—	—	—	7
December ..	—	—	—	2	5	1	1	1	—		—	—	10
Totals ..	—	1	—	7	27	15	11	2	1	—	1	—	65

VYRNWY SUPPLY (Maintenance Works).

Rainfall.

The annual statement of the monthly rainfall on the gathering grounds contributing to Lake Vyrnwy will be found on page 30, Table V.

Oswestry Filter Beds.

During 1908 there were altogether twelve filter beds in use at Oswestry, having a total filtering area of nearly ten acres. Three of these beds—Nos. 2, 3 and 7—were re-sanded, and a fourth—No. 4—which was partially done during 1907, was completed during the year. All the beds were cleaned an average of 6½ times. The interruptions to the working of the filter beds for cleaning and re-sanding were equivalent to rather more than one-eleventh of the filtering area being out of use for the whole of the year.

Diagram of Vyrnwy Stock.

It has been suggested that a diagram should be prepared showing the rise and fall in the contents of Lake Vyrnwy, and the quantity of water overflowing to the river below, similar to the diagram of the Rivington stock given on page 25. Any such diagram would, however, be very misleading, and of no really practical value, because the conditions at Lake Vyrnwy are so entirely different from those at Rivington.

The Rivington scheme has been fully developed, and the rise and fall of the reservoirs shows the working of the system and represents accurately the volume of water available from that source for the supply of Liverpool and of compensation water. The table of contents therefore possesses a definite value and significance. On the other hand the Vyrnwy scheme is only partially developed. Only two out of three, and possibly four, pipe lines for conveying water to Liverpool have been completed.

The whole of the watershed has not yet been utilised, and, further, the quantity contained in the reservoir at any given moment does not bear any necessary relation to the yield of the gathering ground because, in times of flood, water is drawn off through sluices at the bottom of the lake instead of being allowed to accumulate and overflow.

Afforestation at Lake Vyrnwy.

The additional areas planted in the year are numbered 16, 17 and 36C on the Plantation map attached to my Annual Report for 1905.

Vacancies were also filled in No. 14.

The total of these areas is 111·8 acres, and the number of trees planted was 235,650. Of these 178,650 were raised from seed in the Corporation nurseries, and 5,700 were purchased.

The year's work included the felling and clearing of coppice clumps and scrub in old woods, besides the usual pruning, thinning and nursery operations.

The total area of nurseries is now six acres.

Wallasey Pipeline.

A new reflux valve has been fixed on the 21in. Wallasey main in the parish of Picton, so as to give better control over the flow in the event of the delivery having to be temporarily stopped.

Additional facilities for effective maintenance have also been provided by connecting the Walksman's house in Moreton and the Aqueduct Office in Oswestry with the National telephone system.

TABLE V.—VYRNWY RAINFALL FOR THE YEAR 1908.

MONTH. 1908.	Number of days upon which rain fell.	POSITION AND ALTITUDE OF THE GAUGES.											
		Tyn-y-ffridd O.D. 1010 feet.	Fawnog. O.D. 1315 feet.	Bank-cynon, Isaf. O.D. 750 feet.	Bryn-gwyn. O.D. 1311 feet.	Ty-Uchaf. O.D. 860 feet.	Carreg-goch. O.D. 1750 feet.	Lluest-wen. O.D. 1667 feet.	Eunant Bridge. O.D. 830 feet.	Heol-y-ffridd. No. 1. O.D. 912 feet.	Heol-y ffridd. No. 2.	Craig-y-gribin. O.D. 1100 feet.	Llwyn-rhiw. O.D. 1428 feet.
		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
January	13	4·07	4·20	4·56	4.45	4·23	6·40	7·68	7·11	8·07	7·10	5·78	8·20
February	19	4·30	4·60	4·57	3·97	4·58	5·30	5·10	5·18	7·42	6·10	4·12	6·22
March	20	6·46	5·62	5·83	5·45	6·06	7·50	6·24	7·97	11·45	7·84	5·72	8·38
April	17	4·82	4·31	4·09	4·47	4·39	5·62	4·87	4·89	4·97	4·62	4·28	4·98
May	18	3·44	3·57	3·75	3·92	3·63	5·66	4·93	5·59	4·97	4·85	4·58	5·49
June	11	3·95	4·13	4·09	3·88	3·65	4·93	4·57	4·56	4·58	4·54	4·12	4·93
July	11	4·80	4·89	4·97	5·20	5·39	6·56	6.16	6·80	6·47	5·66	5·90	5·88
August	13	3·77	4·07	3·47	4·05	4·19	5·16	5·30	5·18	5·20	5·11	4·64	6·09
September	19	5·29	6·11	5·05	5·75	5·45	7·48	6·99	7·41	7·42	6·95	6·18	7·91
October	10	2·97	3·02	2·65	3·00	2·99	3·50	3·26	2·89	3·04	2·93	2·48	3·10
November	16	4·08	4·33	4·27	4·73	4·23	5·72	6·46	5·80	6·27	5·82	4·98	7·03
December	23	5·34	5·84	5·07	6·30	5·98	7·99	7·42	7·62	8·53	7·30	6·44	8·22
Totals ..	190	53·29	54·69	52·37	55·17	54·77	71·82	68·98	71·00	78·39	68·82	59·22	76·43

Quality of Water.

CHEMICAL ANALYSES.

The monthly samples for chemical examination by Professor J. Campbell Brown, D.Sc., have been regularly supplied. The samples of Rivington and Vyrnwy waters are taken from the Prescot Reservoirs at the outlet ends of the aqueducts. The well samples are taken direct from the pump pipes. The average results obtained are given in Table VI. (page 34).

BACTERIOLOGICAL EXAMINATIONS.

The Bacteriological analyses have been made, as in former years, by Professor Sir Rubert Boyce, F.R.S., at the Thompson-Yates Laboratories, University of Liverpool.

Report of
Professor Sir Rubert Boyce, F.R.S.

"The quality of the water supplied to Liverpool as "indicated by the following daily and monthly examination "shows that its very great bacterial purity is well maintained "for the year 1908.

"For the classification of the minute animal forms, the "bacteriologist is indebted to the services of Mr. R. Newstead, "M.Sc., F.L.S., Lecturer in Entomology. The printing of "his report is postponed until his investigation, which is still "in progress, has been completed.

Daily Examinations—

"The samples analysed this year have been taken from "the main tap in the Johnston Laboratories, the average "number of Bacteria being 19.

"The B. enteritidis sporogenes was absent in all cases, and "the Colon Bacillus was only found in a few samples during "the month of July in the quantity of water examined, viz., "100 c.c. The diagram on page 33 illustrates the variation in "the total number of bacteria per month during the years "1907-1908.

Monthly Examinations—

SAMPLES OF WATER COLLECTED AT PRESCOT.	AverageNo. of Bacteria present per c.c.	Total No. of examinations.
"Vyrnwy Water	12	9
"Rivington Water	10	10
"Mixing Well	30	10
"New Reservoir	26	10

"A very careful watch has, as in the preceding years, been "kept upon the quality of the water derived from the Wells.

SAMPLES OF WELL WATER.	Average No. of Bacteria per c.c.	Total No. of examinations made.
"Dudlow Lane Well	28	10
"George Holt Well	42	9
"John Holmes Well	63	1

Special Examinations—

"One hundred and seven special examinations have been "made this year of the water from the Rivington Watershed, "and a further series has also been specially investigated, "attention being particularly directed to the nature of the "deposit.

Methods of Analysis—

"As in previous years one cubic centimetre forms the basis "for a numerical estimation of the bacteria.

"For the presence of the Colon Bacillus and allied "organisms quantities varying from 50 c.c. to 100 c.c. have "been carefully examined."

Diagram D

Diagram illustrating Monthly average variation in the total number of Bacteria in Liverpool Mains.

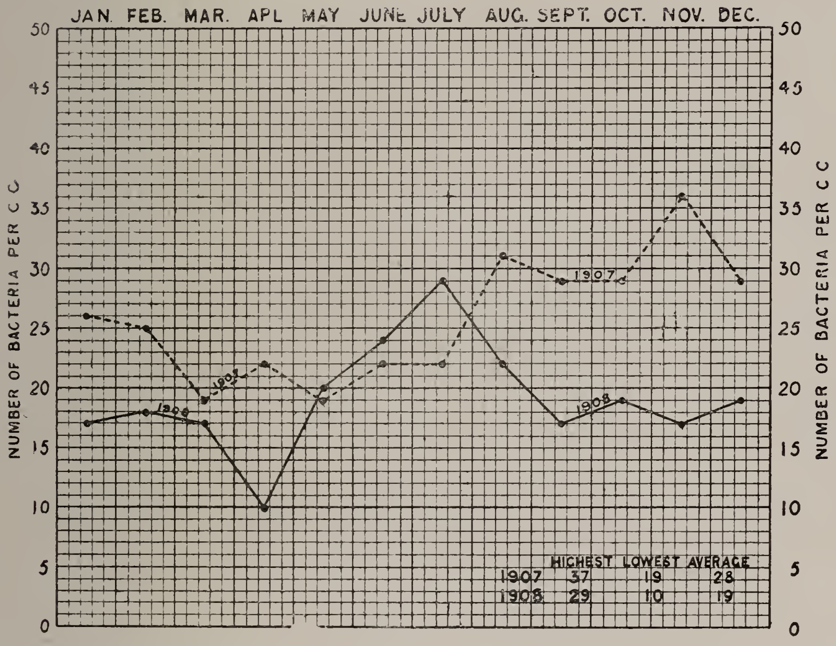


TABLE VI.—CHEMICAL EXAMINATIONS OF LIVERPOOL WATERS, YEAR 1908.

By Prof. J. CAMPBELL BROWN, D.Sc.

AVERAGE RESULTS OF ANALYSES EXPRESSED IN PARTS PER 100,000.

DESCRIPTION.	Total Solid Matter in Solution.	Oxygen required to Oxidise.		Ammonia.	Ammonia from Organic matter by distillation with Alkaline permanganate.	Nitrogen as Nitrates.	Combined Chlorine.	Hardness.
		In 15 Minutes.	In three Hours.					
RIVINGTON (Average of 12 Analyses)	9·75	·023	·046	·002	·006	·011	1·50	° 4·22
VYRNWY (Average of 12 Analyses)	5·23	·085	·160	·000	·006	·000	·90	2·20
DUDLOW LANE (Average of 11 Analyses) ..	19·95	·000	·000	·000	·000	·645	3·00	8·77
GREEN LANE (Average of 10 Analyses) ..	34·23	·000	·000	·000	·000	·561	3·40	22·00
WINDSOR (1 Analysis)	41·40	·000	·000	·002	·002	·872	5·00	29·72

CAPITAL EXPENDITURE ON THE LIVERPOOL WATERWORKS TO 31st DECEMBER, 1908.

(Extracted from the published Accounts of the City Treasurer.)

	£	s.	d.
Harrington and Bootle Companies' Works ...	578,684	2	10
Green Lane Works	71,055	13	11
Extensions of Home Works, (Wells, Service Reservoirs and Mains)	1,135,131	11	11
Rivington Works...	1,713,710	14	6
Chorley Works	31.696	17	8
Vyrnwy Works	2,929,300	1	1
Total	£6.459.579	1	11

REVENUE AND EXPENDITURE.

ORDINARY ACCOUNT.

Revenue for the Year.

	£	s.	d.
Domestic Water Rents at 7½d. in the City and Bootle, and 10½d. outside..............	£88,223	14	5
Public Water Rate in City and added areas	99,452	5	1
Trade and Miscellaneous Supplies...........	96,627	4	1
Supplies to Shipping	34,395	1	4
Supplies to Local Authorities in bulk.........	32,085	1	5
Chorley Waterworks	6,381	13	9
Total.................	£357,165	0	1

Expenditure for the Year.

	£	s.	d.
Working Expenses, including Home Works, Rivington and Vyrnwy	£77,104	14	1
Rates and Taxes	38,406	7	3
Interest on Capital..................................	205,036	2	3
Sinking Funds	37,259	12	0
Chorley Works (excluding Rates and Taxes)	5,988	12	8
Total.................	£363,795	8	3

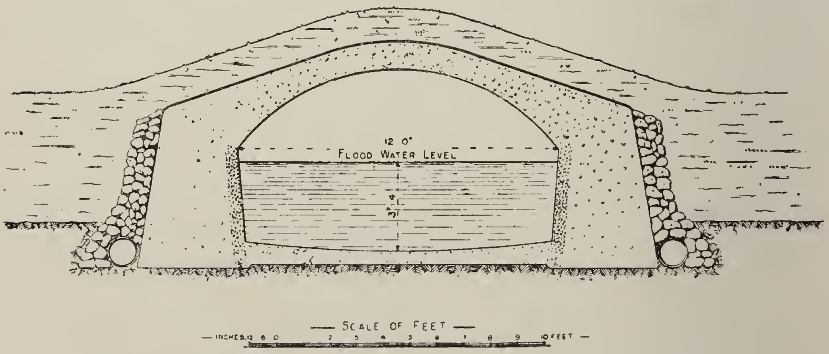
New Works.

Rivington Supply.

Covering of Goit at Brinscall.

In my Annual Report for the year 1905 it was explained that the Goit is an open channel forming part of the original Rivington works and constructed for the purpose of conveying the water impounded in the three upper reservoirs at Withnell to the lower reservoirs of Anglezarke and Rivington. The total length of the channel is 3¾ miles, and for the most part it passes through agricultural lands, but for a length of about 1,000 yards it goes through the village of Brinscall, where there has been of late years a considerable growth of population, many workmen's houses having been built within a few yards of the Goit. The question of covering this length had been under consideration for some years, when, in November, 1904, the Water Committee decided to advertise for tenders to carry out a scheme of culverting. The tender of Messrs. Geo. Bell and Sons, of Tottenham, was accepted in March, 1905, but the work was not commenced until the June following.

The leading dimensions are indicated on the following typical cross-section of the culvert.



The exact length of the culvert is 1,078 yards. It has a uniform gradient throughout of 3·69 feet per mile.

The level of invert at the entrance to the culvert is 532·36 O.D.
and at the outlet end ... ... 530·10 „
The fall is therefore ... ... 2·26 feet

The calculated maximum discharge is in round numbers 100 million gallons per 24 hours.

Three bridges cross the Goit in the length culverted. Of these, two carry public highways while the third carries an occupation road leading to a quarry.

The original masonry structure of these bridges has not been disturbed, the concrete culvert having been widened out and enlarged on each side so as to include the whole waterway of the bridges.

The culvert receives water from several streams flowing from the high ground on the eastern side as well as from the reservoirs. The chief of these is the Whave Brook, which has also been recently protected by culverting.

A specially designed "tipping sluice" has been fixed at the discharge end of the culvert, the object of which is to hold up the water in dry weather to a depth of 2 feet 6 inches, so as to provide the head required to deliver the statutory supply of compensation water to the Brinscall Hall Print Works. A notch cut in this sluice passes the necessary quantity of water to supply the compensation gauge at White Coppice lower down the Goit.

This tipping sluice is pivotted in such a manner that when the level of the water in the culvert rises by reason of extra water being passed down, the sluice falls automatically into a horizontal position, thus releasing the water held up and leaving the full capacity of the culvert available for the passing of heavy floods.

Vyrnwy Supply.

Diversion of River Marchnant Tunnel.

The tunnel between the River Marchnant and Lake Vyrnwy was completed at 6 a.m. on the 16th of April. It was driven from the two ends without any intervening shaft.

The total length of the tunnel is 7,345 feet.

Work was commenced at the inlet end in the Marchnant Valley in January, 1902, and was continued until September, 1906, when a distance of 3,700 feet had been reached.

At the opposite end, on the banks of Lake Vyrnwy, the tunnelling was not commenced until January, 1903, and was continued until the work from the two ends met as stated above, the length driven at the Vyrnwy end being 3,645 feet.

As soon as a junction was effected between the two headings the centre lines were checked from both ends of the tunnel, and it was found that they coincided exactly in a vertical plane. The levels on both sides of the junction were also practically identical.

The photograph shows the actual point at which the headings met. The white spot in the centre is the inlet end of the tunnel, 3,700 feet away.

Concrete and Masonry Dam.

The excavation for the dam across the Marchnant Valley was begun in January, and up to the end of the year 1,675 cubic yards of material had been moved. This excavation will be applied to form an embankment round the entrance to the tunnel.

The river was temporarily diverted through a wooden trough (10 feet 6 inches wide by 3 feet 6 inches deep) laid across the site of the trench, thus enabling the work to be carried up uniformly throughout the length of the dam.

Some difficulty was experienced in securing a solid foundation owing to the very mixed nature of the geological formations. These irregularities were not disclosed by the trial holes which had been sunk, and they caused considerable delay and additional labour.

At the North end of the dam, near to the tunnel mouth, rock was found within six feet of the surface, but from there it dipped very sharply towards the opposite side of the valley. An excellent foundation on good boulder clay was, however, secured at this deeper end within 38 feet of the surface, and from this point the structure will be stepped up into the hillside, where the ground is also of a suitably impermeable nature.

The work of filling in the foundations with concrete, intermingled with large stones, or plums, was commenced in September, and by the end of the year 650 cubic yards had been put in, thus bringing the foundations to within 2 feet 6 inches of the surface of the ground for the greater part of its length and ready for the masonry facing work to be commenced.

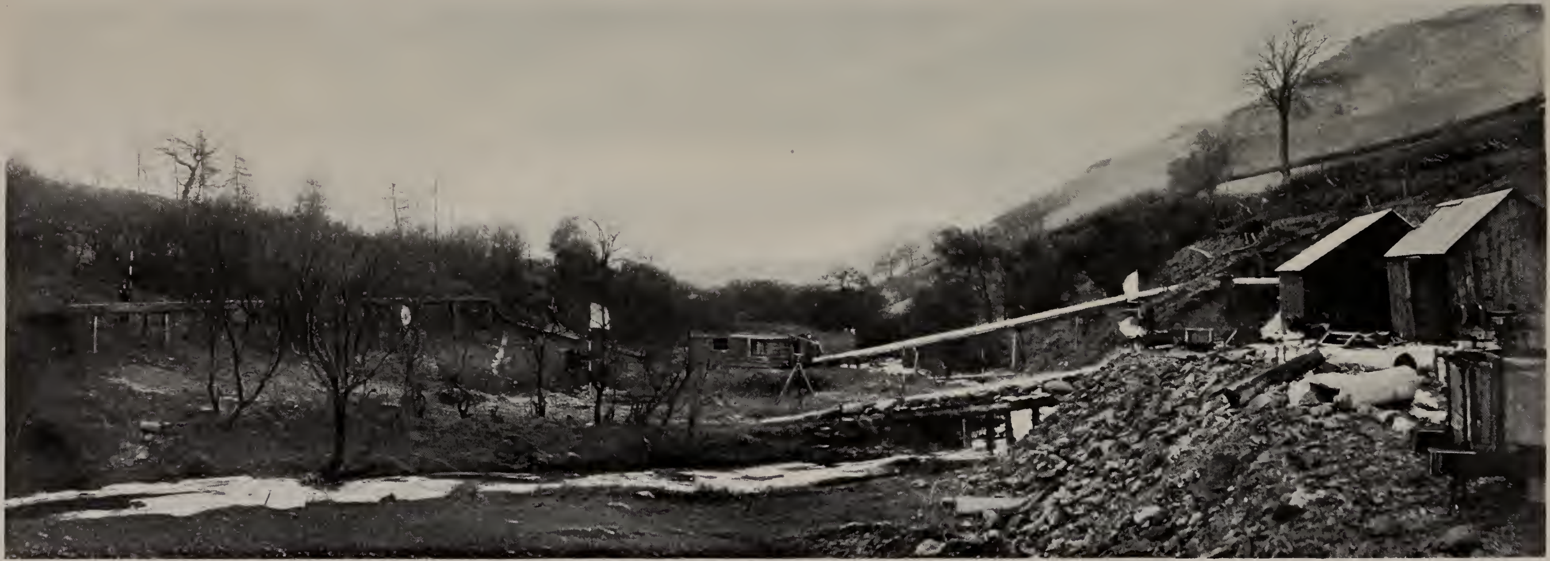
The stone for the masonry is being obtained from the Eunant Quarry at the upper end of Lake Vyrnwy. It is brought down on barges to the outlet end of the tunnel, and then carried on the existing tram road through the tunnel to the inlet end, where it is unloaded. This method of handling is considerably less expensive than the cost of carting the material by road.

The length of the dam between the points where it touches the two natural sides of the valley is 209 feet 6 inches.

The photographs from which the accompanying illustrations have been prepared were taken by the Resident Engineer, Mr. H. N. Giles.

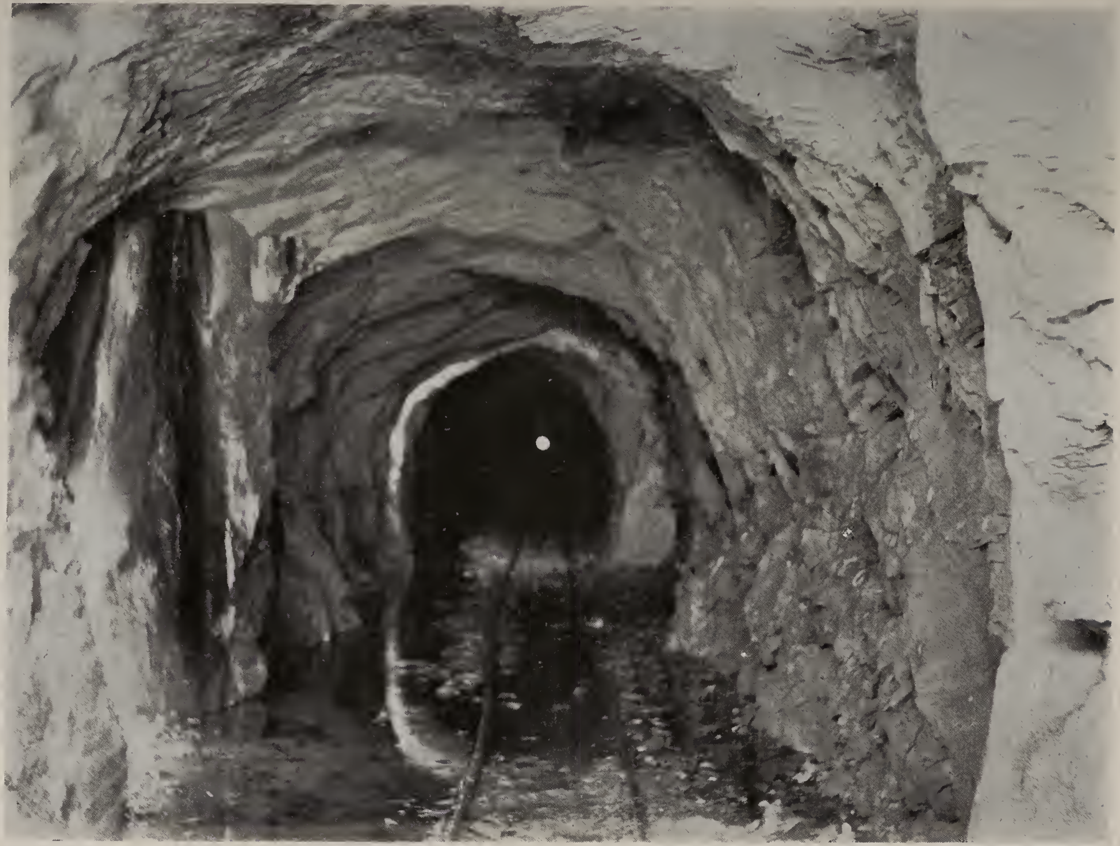
J. PARRY, M.Inst.C.E.

MUNICIPAL OFFICES,
LIVERPOOL, *June*, 1909.



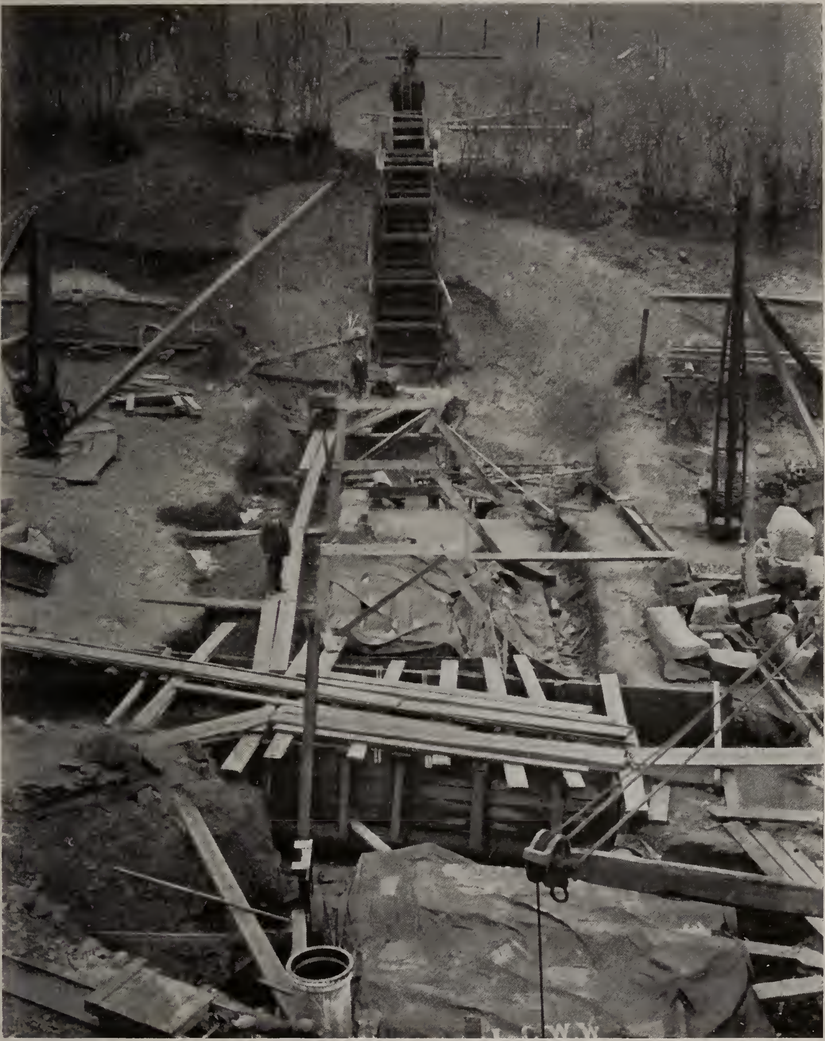
MARCHNANT VALLEY BEFORE COMMENCING CONSTRUCTION OF WORKS.

(Note.—The men with the flags and theodolite are standing on the centre line of the proposed dam. The inlet to the tunnel is seen on the right hand side with the ventilating pipe going into it. The trough on the left side is for carrying water to drive turbine for ventilation.)



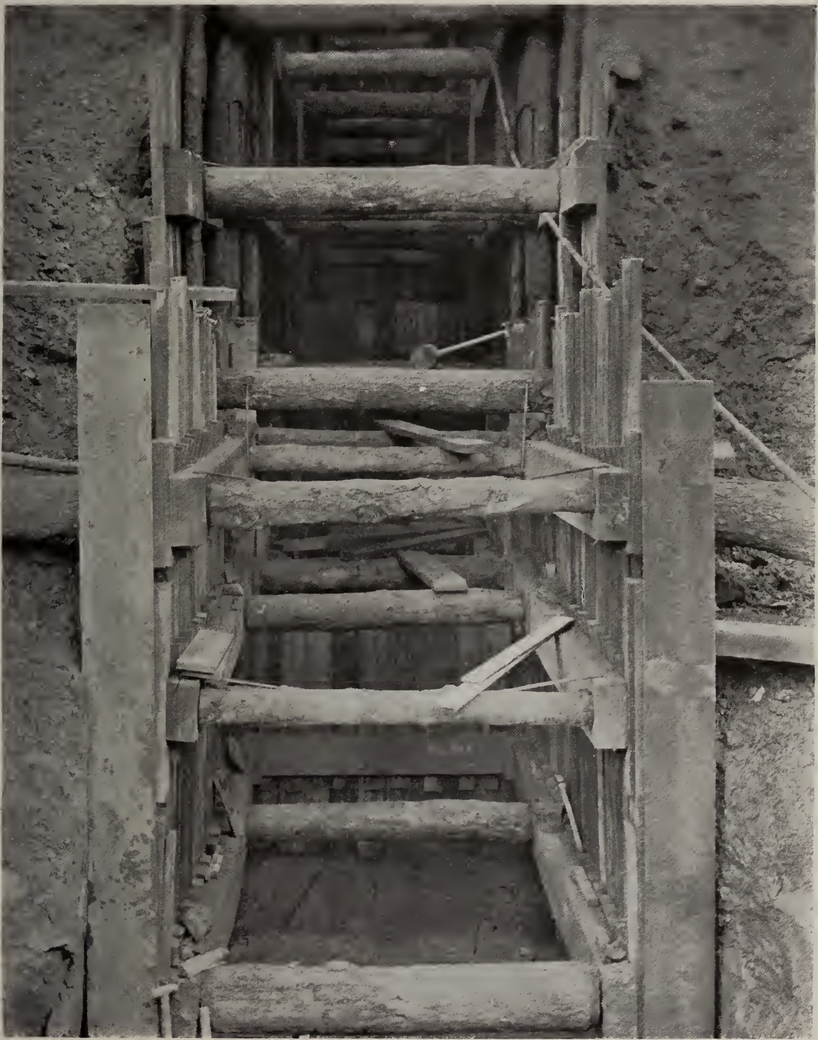
MARCHNANT TUNNEL.

View showing point of meeting near centre of tunnel. The white spot shows daylight at the inlet end, 3,700 feet off.



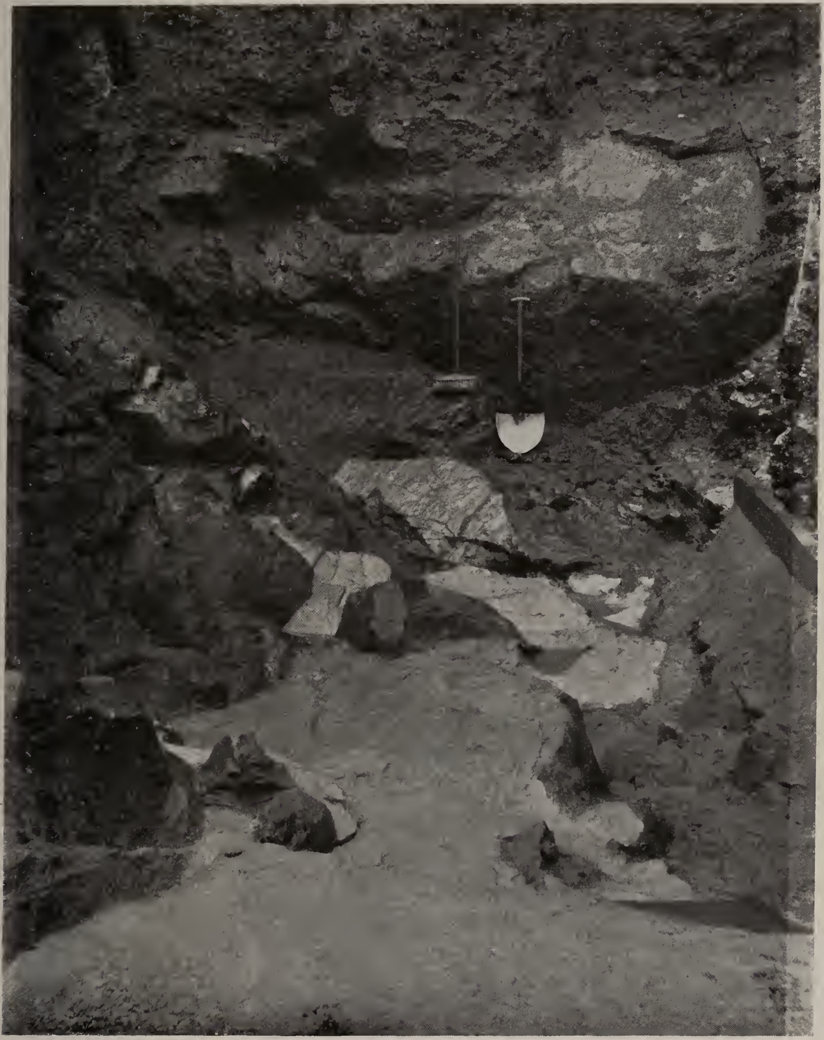
MARCHNANT DAM.

Concrete foundation brought up to within 2 feet 6 inches of ground level. General view of trench on hillside, southern end.



MARCHNANT DAM.

Enlarged view of portion of timbered trench at southern end. For general view, see page 43.



MARCHNANT DAM.

Rock foundation at northern end of dam prepared ready for building.

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